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(54) **SIMPLIFIED THERMAL ISOLATOR FOR TEMPERATURE SENSOR**

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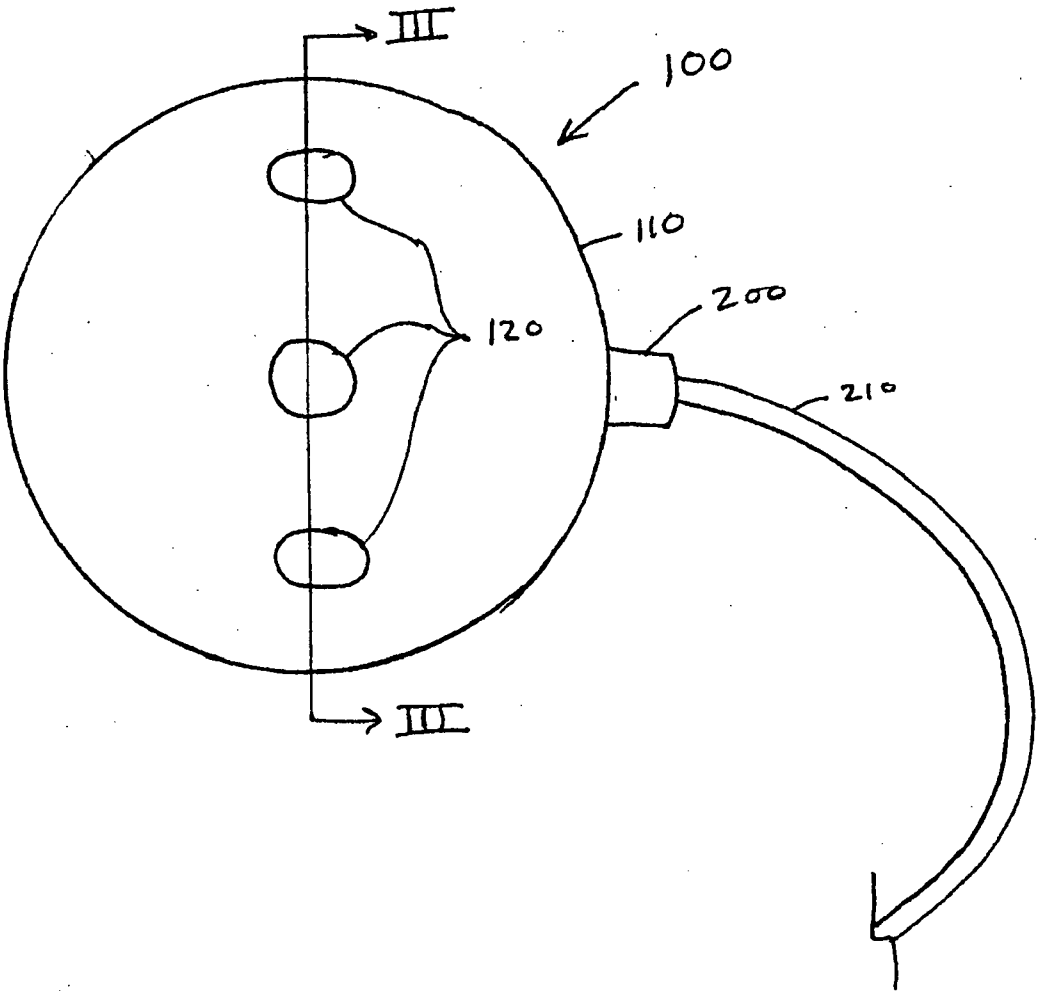
(57) **ABSTRACT**

A thermal isolator is provided for use with a sensor having a sensing element. The isolator has a main body made of a thermally insulating material. The main body has an outer surface, a sensor receiving passage for receiving the sensor, and at least one venting port fluidly communicating with the sensor receiving passage and the outer surface. The sensor receiving passage is adapted to position the sensor such that the sensing element is unreachable by a linear path from the outer surface through any opening in the main body.



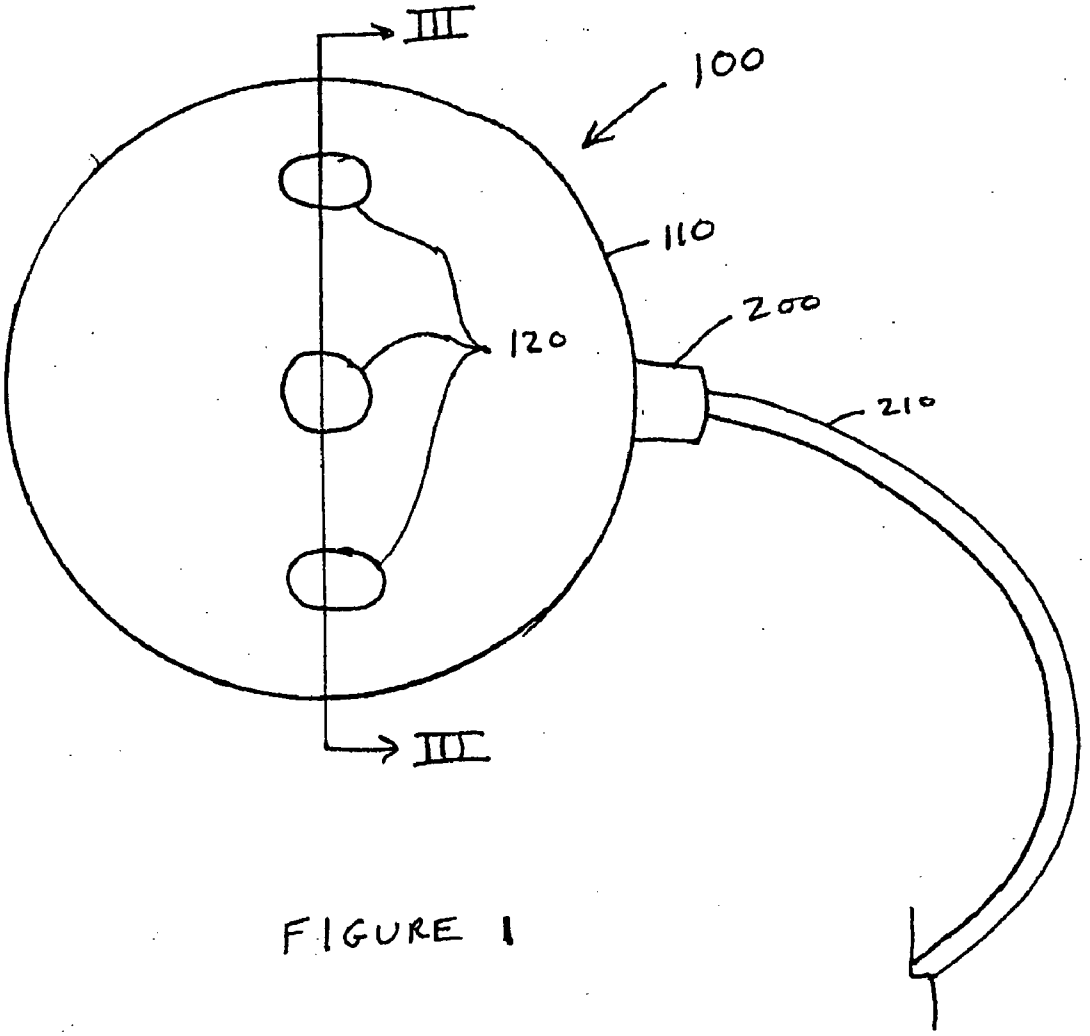


FIGURE 1

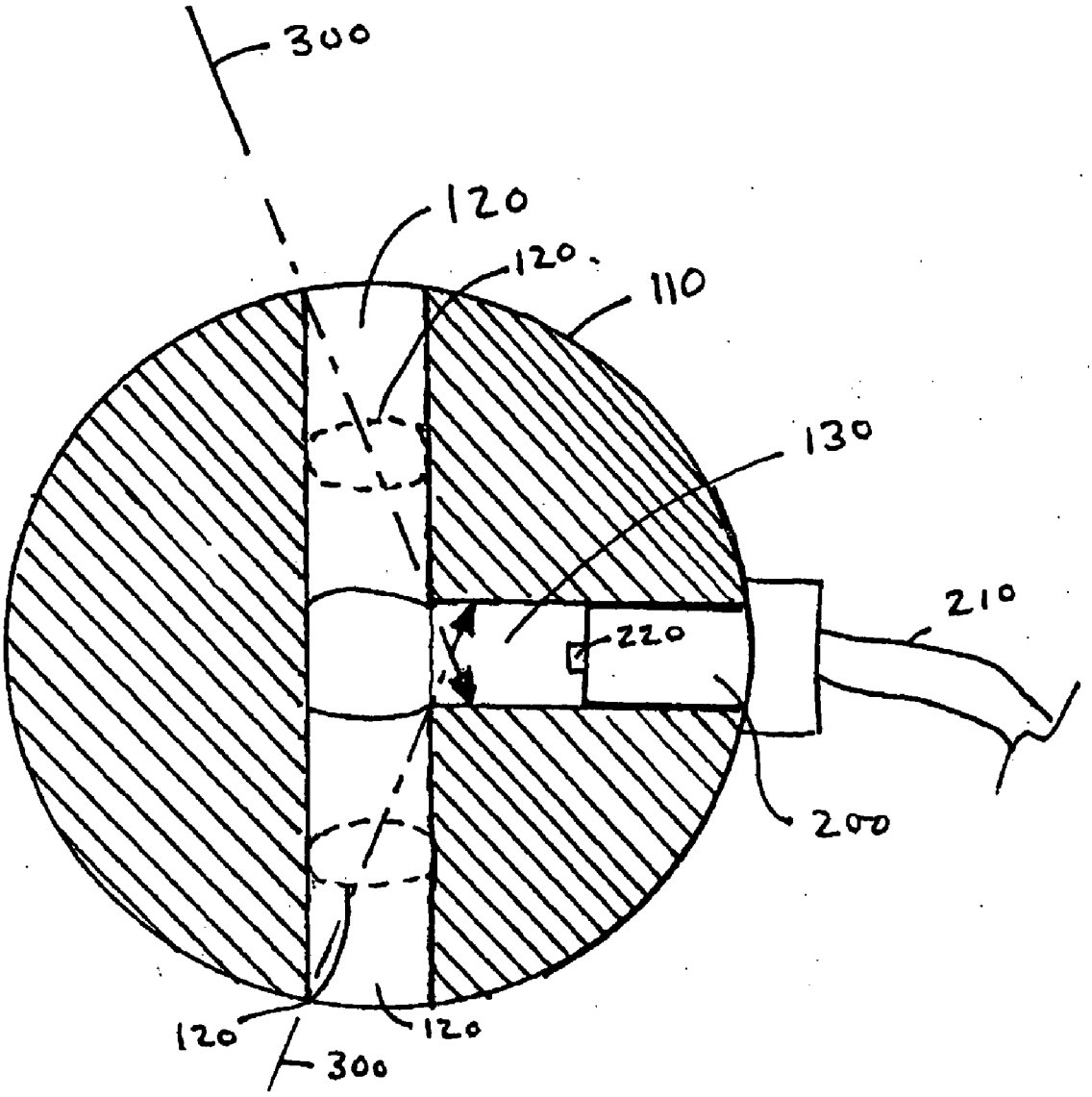


FIGURE 2

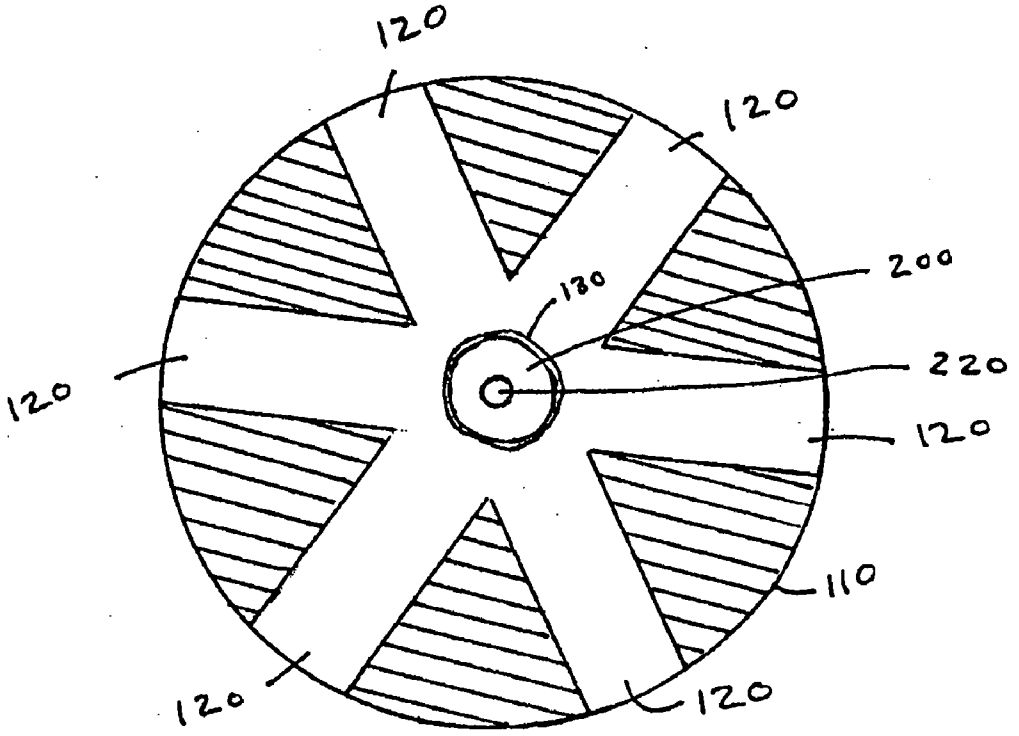


FIGURE 3

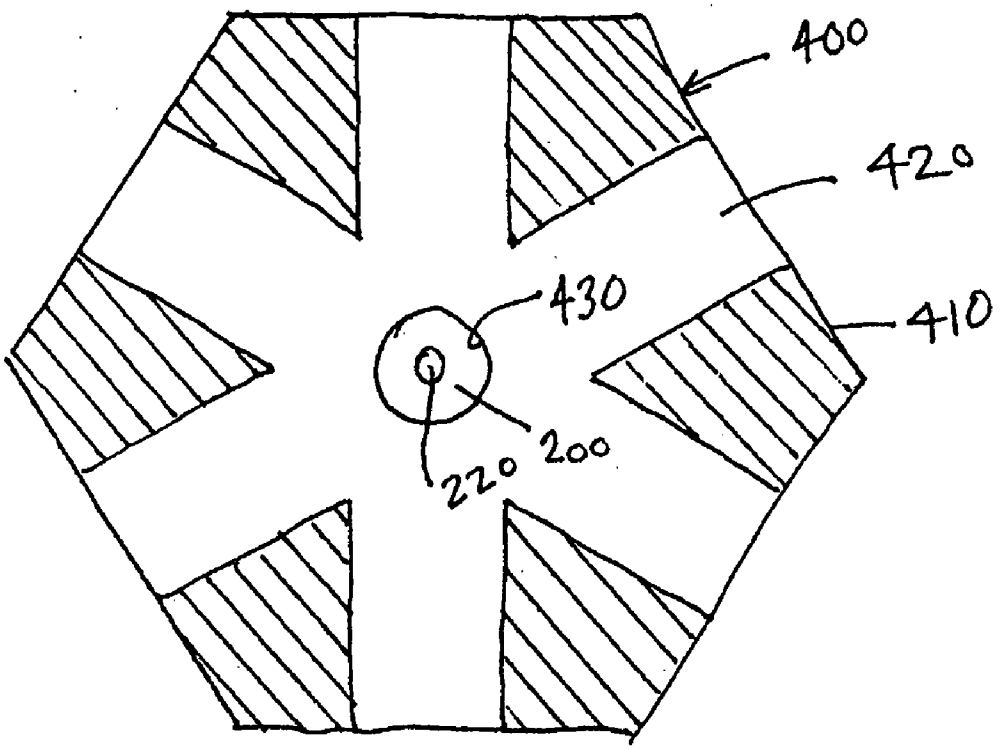


FIGURE 4

SIMPLIFIED THERMAL ISOLATOR FOR TEMPERATURE SENSOR

[0001] This application claims the benefit of U.S. Provisional Patent Application No. 60/660,066 filed Mar. 10, 2005, which is hereby incorporated by reference in its entirety.

BACKGROUND OF THE INVENTION

[0002] The invention relates to the protection of sensors. More particularly, the invention relates to the protection of sensors from sun light or other energy sources. More particularly still, the invention relates to the protection of temperature sensors from sunlight or radiant energy sources.

SUMMARY OF THE INVENTION

[0003] An embodiment of the invention provides a thermal isolator for use with a sensor having a sensing element. The isolator has a main body made of a thermally insulating material. The main body has an outer surface, a sensor receiving passage for receiving the sensor, and at least one venting port fluidly communicating with the sensor receiving passage and the outer surface. The sensor receiving passage is adapted to position the sensor such that the sensing element is unreachable by a linear path from the outer surface through any opening in the main body.

[0004] The invention also provides a thermal isolator for use with a sensor having a sensing element. The isolator has a main body made of a thermally insulating material. The main body has an outer surface, a sensor receiving passage for receiving the sensor, and at least one venting port fluidly communicating with the sensor receiving passage and the outer surface. The sensor receiving passage is adapted to position the sensor such that the sensing element is not directly viewable from the outer surface through any opening in the main body.

BRIEF DESCRIPTION OF THE DRAWINGS

[0005] Further advantages and details of the invention follow from the exemplary embodiments and are explained in the following with the aid of the Figures, in which:

[0006] **FIG. 1** is a side view of a first example of a thermal isolator in accordance with the invention;

[0007] **FIG. 2** is a sectional view of the isolator shown in **FIG. 1**;

[0008] **FIG. 3** is a sectional view of the isolator shown in **FIG. 1** taken along section line II-II; and

[0009] **FIG. 4** is a sectional view of a second example of a thermal isolator in accordance with the invention.

DETAILED DESCRIPTION OF THE INVENTION

[0010] The invention will be described using the example of a thermal isolator for use with a temperature sensor. It is noted however that the invention can also be applied to other temperature sensor applications.

[0011] Temperature sensors are used in various situations to determine the temperature of a specific thing and/or a specific location. In many cases, the sensed temperature reading is used in a calculation for determining some other quantity. An example of such a calculation is a calculation for determining air density based on the temperature of the air.

[0012] Various external input can negatively affect the accuracy of a temperature sensor. For example, direct sunlight or radiant heat from, for example, a vehicle motor can increase the temperature reading of a temperature sensor and thus result in a reading that does not accurately reflect the ambient air temperature being measured. Sheets of material can be used to shield a temperature sensor from direct sunlight and other radiant energy sources. However, such shields can trap air heated by the energy source such that the sensor sees a temperature higher than the temperature of the ambient air. Shields can also be limited in the protection they provide when the sun or the source of radiant heat moves. The invention solves these problems in a very effective and inexpensive way.

[0013] An example of the invention will be described that uses cellular foam as the material for the thermal insulator. It is noted, however, that other thermally insulating materials can also be used. Cellular foam is a particularly good material to use for the thermal isolator because,.apart from its insulating properties, it can protect the temperature sensor from physical damage.

[0014] **FIG. 1** shows an external view of a thermal isolator **100** that is an example of the invention. Thermal isolator **100** has a body **110** that is, in this example, spherical in shape. Body **110** of thermal isolator **100** is preferably made of a cellular foam material for at least the reasons discussed above. **FIGS. 2 and 3** show sectional views of thermal isolator **100** that reveal a plurality, in this case six, venting ports **120** that are fluidly connected to a sensor receiving passage **130**. Although six symmetrical venting ports are shown in this example, any number of venting ports and/or many non-symmetrical configurations can be used.

[0015] Sensor receiving passage **130** is adapted to receive a sensor **200** having a sensing element **220** such that sensing element **220** can measure conditions within sensor receiving passage **130**. In this example, sensor **200** is a temperature sensor and sensing element **220** measures the temperature that exists in sensor receiving passage **130**. The temperature of the air in sensor receiving passage **130** should, do to the features of the invention, be within an acceptable range of error when compared to the ambient air surrounding thermal isolator **100**. Sensor **200** is connected, in this example, by a wire **210** to equipment that processes the output of sensor **200**. It is noted that other types of connections, including wireless connections, could be used in lieu of, or in addition to, wire **210**.

[0016] **FIG. 2** shows light, or energy, paths **300**. These paths represent rays of light or paths of other radiant energy in the vicinity of thermal insulator **100**. Venting ports **120**, sensor receiving passage **130**, and the location of sensing element **220** in sensor receiving passage **130** are designed in the invention to ensure that no ray or beam (represented by exemplary paths **300**) can directly touch sensing element **220**. Venting ports **120** provide paths for natural convection in addition to preventing sunlight or radiant heat from directly impinging on sensing element **220**. By this natural convection, a good portion of any heat that builds up inside thermal insulator **100** can be transferred to the ambient air outside of thermal insulator **100**.

[0017] Body **110** of thermal isolator **100** can be colored to serve one or more purposes. While a white color serves to repel the absorption of heat, naturally white foam may not lend itself to long term exposure to sunlight without some form of undesirable degradation. As a result, a foamed material that is best suited to survive the effects of outdoor weathering may first be selected and then the exposed surfaces of the foam pigmented to add the necessary level of thermal reflection. In some instances, it may be desired to coat body **110** with an appropriate color that best suits a specific aesthetic requirement (such as camouflaging) while still maintaining an exceptional level of solar reflectivity.

[0018] Body **110** can be made, for example, of a closed cell foam or an open celled structure. While a closed cell foam may be a more desirable material from a heat insulation standpoint, the invention is not limited to the use of closed cell material.

[0019] **FIG. 4** shows an alternate embodiment of the invention. In the embodiment shown in **FIG. 4**, a thermal isolator **400** has a body **410** through which venting ports **420** are provided. In addition, a sensor receiving passage **430** is provided for housing sensor **200**. **FIG. 4** is analogous to **FIG. 3**, but shows a cross-section of a hexagonal shaped insulator as opposed to the spherical shaped insulator of **FIG. 3**. The embodiment shown in **FIG. 4** has the advantage that it may simpler and/or less expensive to manufacture than the spherical embodiment. From the teachings of this disclosure, it would be apparent to one skilled in the art that shapes other than spherical and hexagonal can be used for a thermal insulator in accordance with the invention.

[0020] The invention is not limited to the above-described exemplary embodiments. It will be apparent, based on this disclosure, to one of ordinary skill in the art that many changes and modifications can be made to the invention without departing from the spirit and scope thereof.

What is claimed is:

1. A thermal isolator for use with a sensor having a sensing element, the isolator comprising:

a main body made of a thermally insulating material, the main body having an outer surface;

a sensor receiving passage for receiving the sensor; and

at least one venting port fluidly communicating with the sensor receiving passage and the outer surface,

wherein the sensor receiving passage is adapted to position the sensor such that the sensing element is unreachable by a linear path from the outer surface through any opening in the main body.

2. The thermal isolator of claim 1, wherein the venting port is a cylindrical passage passing completely through the main body.

3. The thermal isolator of claim 2, wherein an axis of the venting port is perpendicular to an axis of the sensor receiving passage.

4. The thermal isolator of claim 1, wherein the sensor is a temperature sensor.

5. The thermal isolator of claim 1, wherein the at least one venting port is a plurality of venting ports.

6. The thermal isolator of claim 5, wherein at least two of the venting ports are cylindrical passages passing completely through the main body.

7. The thermal isolator of claim 6, wherein the at least two venting ports each have an axis, the axes of the at least two venting ports being perpendicular to an axis of the sensor receiving passage.

8. The thermal isolator of claim 7, wherein the main body is spherical.

9. The thermal isolator of claim 7, wherein the main body is a hexagonal prism.

10. The thermal isolator of claim 9, wherein the main body is a right regular hexagonal prism.

11. A thermal isolator for use with a temperature sensor having a sensing element, the isolator comprising:

a main body made of a thermally insulating material, the main body having an outer surface;

a sensor receiving passage for receiving the sensor; and

at least one venting port fluidly communicating with the sensor receiving passage and the outer surface,

wherein the sensor receiving passage is adapted to position the sensor such that the sensing element is not directly viewable from the outer surface through any opening in the main body.

12. The thermal isolator of claim 11, wherein the venting port is a cylindrical passage passing completely through the main body.

13. The thermal isolator of claim 12, wherein an axis of the venting port is perpendicular to an axis of the sensor receiving passage.

14. The thermal isolator of claim 11, wherein the sensor is a temperature sensor.

15. The thermal isolator of claim 11, wherein the at least one venting port is a plurality of venting ports.

16. The thermal isolator of claim 15,.wherein at least two of the venting ports are cylindrical passages passing completely through the main body.

17. The thermal isolator of claim 16, wherein the at least two venting ports each have an axis, the axes of the at least two venting ports being perpendicular to an axis of the sensor receiving passage.

18. The thermal isolator of claim 17, wherein the main body is spherical.

19. The thermal isolator of claim 17, wherein the main body is a hexagonal prism.

20. The thermal isolator of claim 19, wherein the main body is a right regular hexagonal prism.

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